

*Water Use Characteristics*



### 3.1 INTRODUCTION

This chapter describes current water use by each of the three water demand sectors in the Santa Cruz Active Management Area (AMA): municipal, industrial, and agricultural users. Natural system demands including riparian demand and water outflow from the AMA are also discussed. Water use patterns for each demand sector are described, including past trends in water use and anticipated growth patterns. Finally, a table of recent demands per year is presented which illustrates the volume of water needed on an AMA-wide scale to be able to meet those demands. The table shows the trend in increasing demand in certain sectors. As demands increase beyond current levels, additional supplies will need to be obtained in order to maintain safe-yield conditions. The table does not address local water table level conditions. Chapters 2 and 8 describe localized water table level conditions and methods by which water supplies may be distributed in order to meet the portion of the AMA goal that requires that long-term declines in local water table levels be prevented.

The Santa Cruz AMA includes most of Santa Cruz County and a small portion of southern Pima County. The major communities include the City of Nogales, Rio Rico, Tubac, and Amado. Based on data from the Arizona Department of Economic Security (ADES), the Arizona Department of Water Resources (Department) estimated that 34,623 persons resided within the Santa Cruz AMA in 1997. Population in the AMA is projected to increase to 58,480 persons by 2025 (ADWR and ADES, 1997). Population is concentrated along the Santa Cruz River corridor and at Nogales, Arizona. The Santa Cruz AMA also experiences a large fluctuation in temporary residents attributable to the close business and family connections between the AMA and the Mexican state of Sonora.

Numerous families, both in the Santa Cruz AMA and throughout the state, have relatives in Mexico. This accounts for much of the travel through Nogales, Arizona and Nogales, Sonora. Nogales is also a center for tourism and commerce as a port of entry for many products, including a significant volume of produce from Mexico and other central and even South American countries. These factors, along with others, combine to make Nogales, Arizona and Nogales, Sonora the largest international transit corridor in Arizona. Small commercial properties, government facilities, schools and hotels continue to grow in order to serve traffic passing through. Municipal water demands will increase as economic growth continues.

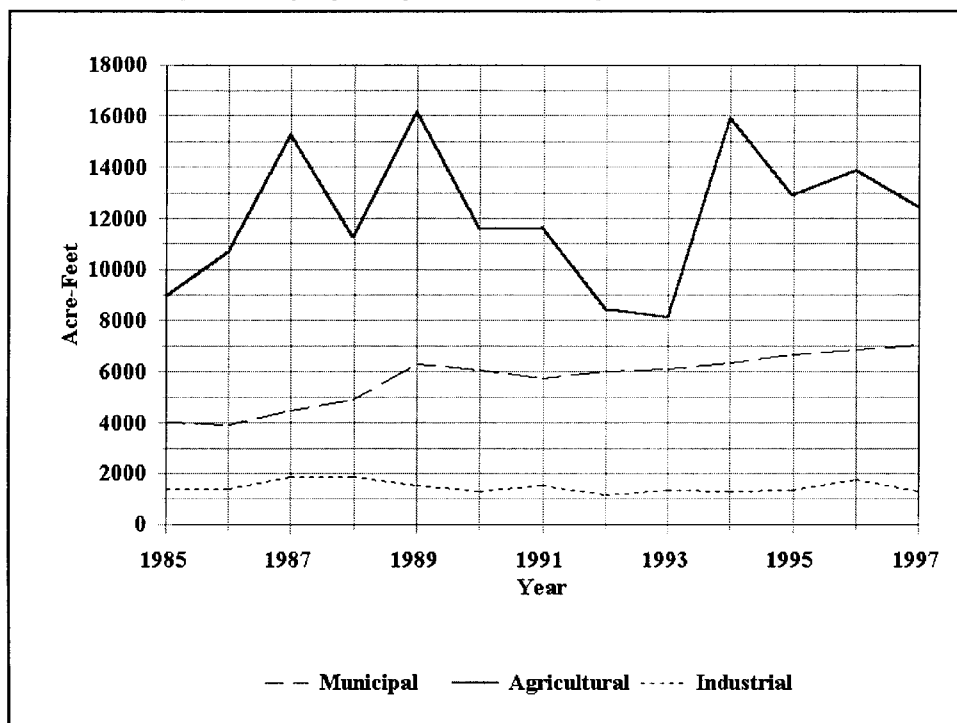
Nogales, Sonora is a center for *maquiladoras*, American owned factories in Mexico which provide economic opportunities on both sides of the border. Distribution warehouses in Nogales, Arizona ship large volumes of agricultural produce and manufactured goods from Mexico throughout the United States. Much of the growth in Rio Rico and Nogales, Arizona is attributable to these employment sectors. The impact of the North American Free Trade Agreement (NAFTA) and the stability of the Mexican currency will undoubtedly play a key role determining whether economic prosperity will continue to create new jobs in the area.

Residential growth has also been fueled by an increase in retirement communities and business commuters from the Tucson metropolitan area. Single family homes are the dominant pattern in housing. New residential subdivisions are under construction in the Tubac, Rio Rico, and Nogales areas. Several thousand residential lots in Rio Rico have been platted but are not yet developed.

Each water demand sector has unique water use characteristics that affect the trend in demand. Agricultural demand includes water used for crop irrigation by irrigation grandfathered right holders. Municipal demand includes water supplied by cities, towns, and private water companies for domestic, industrial, and commercial purposes. Municipal demand does not include water withdrawn from individually owned, small wells (wells that pump less than or equal to 35 gallons per minute). These small wells are exempt from the Department's water use reporting and water conservation requirements. Industrial demand includes water withdrawn pursuant to non-irrigation grandfathered rights or permits for industrial purposes. Figure 3-1 shows the volume of water used by each of the three water demand sectors

from 1985 through 1997. Table 3-1 shows the proportion of the total AMA water use each sector comprised in 1985, 1990, and 1995.

**FIGURE 3-1**  
**WATER USE BY SECTOR**  
**1985 - 1997**  
**SANTA CRUZ ACTIVE MANAGEMENT AREA**



**TABLE 3-1**  
**WATER USE BY SECTOR**  
**1985, 1990, AND 1995**  
**SANTA CRUZ ACTIVE MANAGEMENT AREA**

Sector	1985		1990		1995	
	Total Use (Acre-feet)	% of AMA	Total Use (Acre-feet)	% of AMA	Total Use (Acre-feet)	% of AMA <sup>2</sup>
Agricultural	8,960	62	11,603	61	12,884 <sup>1</sup>	62
Municipal	4,027	28	6,068	32	6,674	32
Industrial	1,393	10	1,328	7	1,363	7
<b>TOTAL</b>	<b>14,380</b>	<b>100</b>	<b>18,999</b>	<b>100</b>	<b>20,921</b>	<b>100</b>

<sup>1</sup> 1995 agricultural data do not include the water usage of exempt small rights; rights <10 acres in size were deregulated in 1994.

<sup>2</sup> Numbers may not add up to 100 due to rounding.

NOTE: Municipal water use associated with exempt wells (wells that pump less than or equal to 35 gallons per minute) is not shown.

In this chapter, the following topics are discussed in the order listed:

- Agricultural Water Use Characteristics
- Municipal Water Use Characteristics
- Industrial Water Use Characteristics
- Average Annual Water Demands (1982-1995)
- Conclusions

### **3.2 AGRICULTURAL WATER USE CHARACTERISTICS**

Certificates of Irrigation Grandfathered Rights (IGFRs) were issued to farmers in the early 1980s if two or more acres of land were irrigated between 1975 and 1980. In 1994, legislation removed the conservation requirements for IGFRs that were 10 acres or less in size, provided they were not part of an integrated farming operation. Certificates of IGFRs designate the number of irrigation acres allowed to be irrigated. A water duty and a maximum annual allotment for water withdrawn from wells are established by the management plan for each IGFR (see Chapter 4). With few exceptions, no new land greater than two acres in size can be irrigated within an AMA.

In addition to being issued an IGFR, many farmers within the Santa Cruz AMA also filed a claim for a surface water right since during historical times water has been diverted from the Santa Cruz River for beneficial uses. In the Santa Cruz AMA, since all water withdrawn from wells is regulated for compliance under the water conservation requirements, all water withdrawn, regardless of its source (surface water, groundwater, or effluent), must be reported to the Department and included in the compliance calculation.

The total amount of water currently allocated annually under the Second Management Plan to all IGFRs in the Santa Cruz AMA is approximately 23,000 acre-feet. If the holder of an IGFR uses less than the total annual water allotment for his acreage, the unused portion is credited in an irrigation flexibility account for that IGFR. The balance in this account is cumulative. Flexibility accounts may be debited if more than the annual water allotment is used; however, debits may only be accrued up to 50 percent of the annual water allotment. Water demand in excess of the maximum debit limit is considered a violation of the conservation requirement and may result in compliance action by the Department. The total amount of flexibility account (flex) credits accumulated by the end of 1995 for all Santa Cruz AMA IGFRs was about 114,000 acre-feet. Most IGFRs have accumulated many credits. While some farms have fewer credits, there are currently no farms in the Santa Cruz AMA in a debit situation.

The Department's analysis of the annual water use data for Santa Cruz AMA IGFRs for the years 1992 through 1997 indicates that water use for most IGFRs already has been less than the final Second Management Plan maximum annual groundwater allotment, which was calculated based upon an assigned irrigation efficiency of 85 percent for most farms. This analysis is depicted in Table 3-2.

As displayed in Table 3-2, in any given year, more than a third of the regulated IGFRs do not use any water. Of the rights that used water during the period from 1992 through 1997, between 42 and 25 percent used less than half of the Second Management Plan final allotment. Many of these rights may have been sold and fallowed their land while a sale was pending. Many right holders are planting less than the maximum allowable acres for their farm each year. Some farms no longer double crop. IGFRs continue to accrue flex account credits in years where water is not used. With the trend in agricultural land being sold to developers in the Santa Cruz AMA, it is anticipated that more and more rights will become fallow and credits will continue to accrue.

**TABLE 3-2**  
**WATER USE BY LARGE AGRICULTURAL RIGHTS**  
**COMPARED TO SECOND MANAGEMENT PLAN FINAL ALLOTMENT**  
**SANTA CRUZ ACTIVE MANAGEMENT AREA**

Year	1992	1993	1994	1995	1996	1997
# of Rights ≥ 10 Irrigation Acres	64	65	64	65	65	65
# of Rights Using With Zero Use <sup>1</sup>	24	27	23	27	27	25
# of Rights Using > Zero but ≤50% of SMP Final Allotment <sup>2</sup>	27	22	22	19	16	16
# of Rights Using > 50% of SMP Final Allotment but ≤SMP Final Allotment	8	11	12	12	14	18
# of Rights Using > SMP Final Allotment	5	5	7	7	8	6

<sup>1</sup> These rights reported zero water use for the calendar year. Many of these rights are no longer farmed. Several have been conveyed to development interests. These rights will continue to accrue flex credits even in this "dormant" state.

<sup>2</sup> The 50% break was used to illustrate the number of farms that are not irrigating their full acreage. The 50% break has no regulatory or statutory significance.

SMP = Second Management Plan

Most of the agricultural flex credits will probably not be used since they can only be used pursuant to an IGFR. Accumulated credits may be used on some IGFRs as conservation requirements become more stringent and in cases where farms irrigate full acreage or double crop. Also, under certain conditions, farmers may transfer flex credits accumulated during the preceding calendar year from one IGFR to another. This provision provides flexibility in the types of crops and amount of acreage (not to exceed the maximum number of acres allowed) that farmers may choose to irrigate and to avoid being in a flex debit or noncompliance situation.

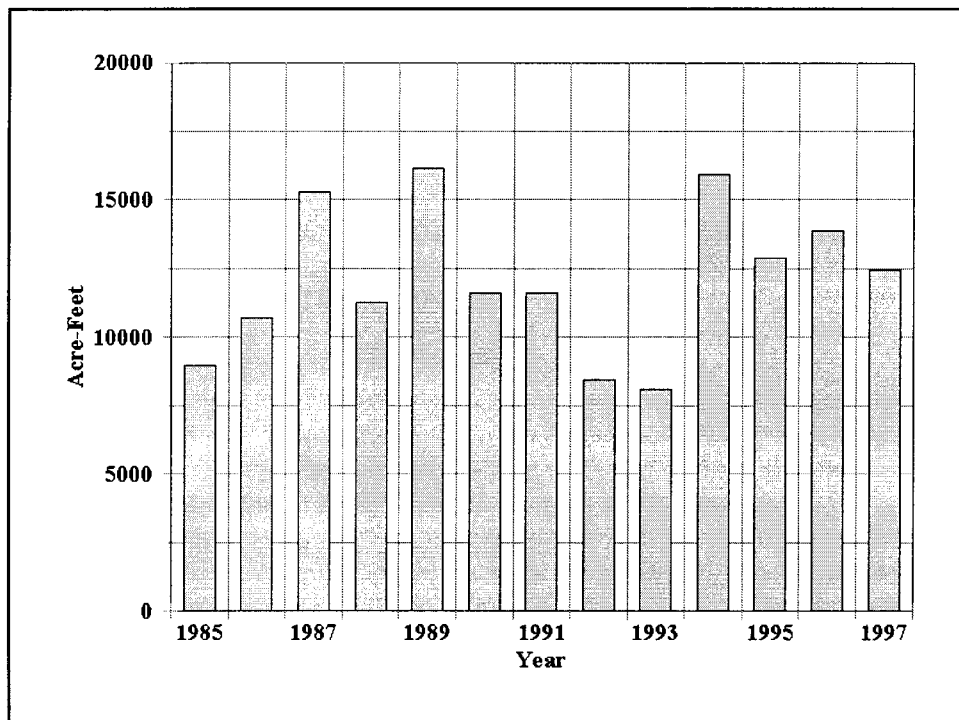
Forage crops, such as winter wheat, alfalfa, bermuda grass, sorghum, native pasture, and fescue are the major crops grown in the Santa Cruz AMA. Other crops grown in the AMA include vegetables and grapes. The Department does not collect information from farmers on an annual basis regarding cropping patterns; however, an informal survey was conducted in 1994 during the preparation of the Third Management Plan. There were about 2,100 acres cropped in 1994, which represents less than 40 percent of maximum acreage that can be irrigated in the AMA pursuant to IGFRs. The most common method of applying water to crops in the AMA is flood irrigation systems; however, some farms are making use of sprinkler irrigation systems and drip systems.

### **3.2.1 Agricultural Demand**

Currently, there are about 65 IGFRs regulated with water conservation requirements in the Santa Cruz AMA. Figure 3-3 shows the location of IGFR irrigable acreage in the Santa Cruz AMA. An IGFR is monitored for compliance with its conservation requirement if it is over 10 acres in size or less than 10 acres in size but part of an integrated farming operation. The irrigation acres associated with these rights total about 5,300 acres with a maximum annual groundwater allotment of more than 20,000 acre-feet. Agricultural water use currently accounts for just under two-thirds of the total annual water use in the Santa Cruz AMA. Water demand is influenced by many factors that vary annually, including weather. However, the total agricultural water use in the Santa Cruz AMA is strongly affected by the single largest IGFR, which is owned by Rio Rico Properties. Annual fluctuations in Rio Rico Properties' water use can be partly attributed to a statutory provision which states that owners of surface water rights may lose those rights if they fail or cease to use appropriated water for five successive years. A.R.S. § 45-141. Figure 3-2

graphs agricultural water use from the years 1984 to 1997. The years 1992 and 1993 were cooler and wetter than other years during the period and water use was correspondingly less.

**FIGURE 3-2**  
**HISTORIC AGRICULTURAL DEMAND (ACRE-FEET)**  
**1985-1997**  
**SANTA CRUZ ACTIVE MANAGEMENT AREA**



Water application rates vary considerably from farm to farm in the Santa Cruz AMA. The 1994 survey collected information on cropped acres, crops grown and total water use for the twenty largest agricultural users in the Santa Cruz AMA. For these users, water was applied to the crops at an average rate of 7.4 acre-feet per acre not considering double cropping. However, this figure is strongly influenced by the application rate of Rio Rico Properties. Water use efficiencies within the Santa Cruz AMA also vary considerably from farm to farm with some farms deficit irrigating and other farms attempting to periodically demonstrate use consistent with their surface water rights claims.

### **3.3 MUNICIPAL WATER USE CHARACTERISTICS**

The Groundwater Code (Code) defines municipal use as “all non-irrigation uses of water supplied by a city, town, private water company or irrigation district...” A.R.S. § 45-561.11. Municipal water providers serve water pursuant to service area rights and may be operated by incorporated cities and towns or by private water companies. A private water company may be a member-owned or corporately-owned entity which distributes or sells water and is regulated by the Arizona Corporation Commission. The Department also regulates the following entities as water providers if they withdraw water from one or more non-exempt wells (wells that pump over 35 gallons per minute): mobile home parks; well cooperatives; homeowners’ associations; and large institutional facilities such as schools, prisons, and military installations. By definition, large municipal providers serve over 250 acre-feet of water (about 81 million gallons) per year and small municipal providers annually serve 250 acre-feet of water or less. There are 14 water providers in the Santa Cruz AMA regulated under the municipal conservation program. Water provider service areas are located on Figure 3-4.

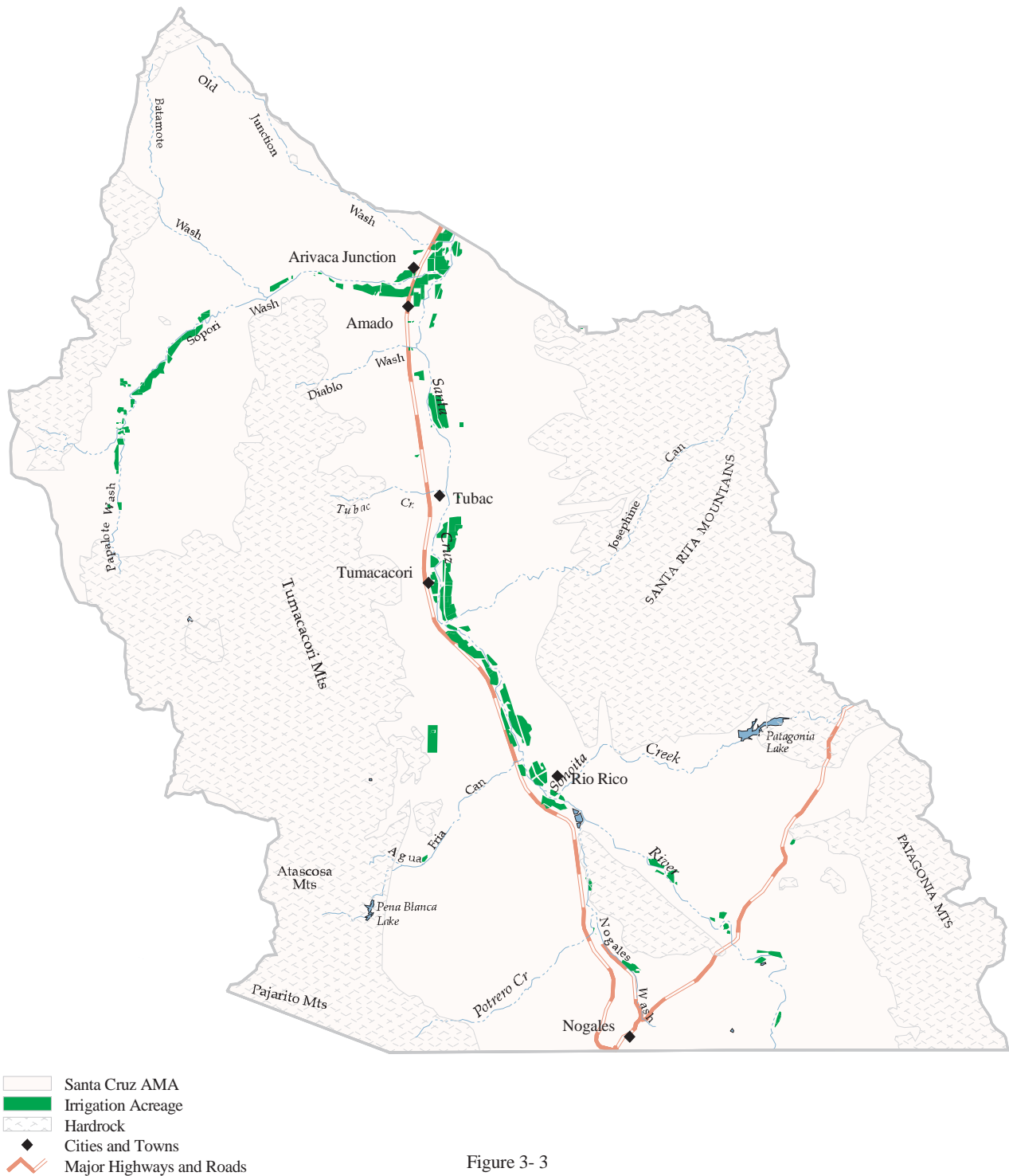


Figure 3-3

## Irrigated Acreage



Santa Cruz AMA 3- 6

ORIGINAL SOURCE  
Arizona Department of Water Resources  
Geographic Information System

Municipal water use is analyzed volumetrically and in terms of the average gallons per capita per day (GPCD) rate of the water users. This form of analysis allows a comparison of the relative water use per customer of each water provider to its GPCD conservation requirement and is used to assess conservation potential. The GPCD conservation requirement for water providers is an allocation tool that has the effect of quantifying the service area right based on population served. Table 3-3 shows population, water use, and GPCD rates for municipal providers in the Santa Cruz AMA for 1985, 1990 and 1995.

**TABLE 3-3  
MUNICIPAL PROVIDER WATER USE 1985, 1990, AND 1995  
SANTA CRUZ ACTIVE MANAGEMENT AREA**

<b>Year</b>	<b>Population</b>	<b>Total Use (Acre-Feet)</b>	<b>Total GPCD</b>
<b>1985</b>	20,247	4,027	178
<b>1990</b>	27,234	6,068	199
<b>1995</b>	31,453	6,674	189

### **3.3.1 Municipal Demand**

Municipal water demand has increased with population growth. Municipal providers are required to meet water conservation requirements, as described in Chapter 5. Water use by the municipal sector is expected to continue to increase during the third management period, which will increase the challenge to maintain the AMA goals. The Department and the local community will have to continue to work closely to ensure that new development is consistent with the AMA goals. This will require creative water management solutions as well as some statutory and rule changes.

Table 3-4 shows historic municipal demand in the Santa Cruz AMA by the four large municipal providers and the sum of small municipal providers from 1985 through 1997. The four large providers and the small providers as a whole have steadily increased water demand since 1985. Rio Rico has grown significantly since 1985. The following section discusses water use patterns within the four large municipal provider service areas and historic water use by small municipal providers in the Santa Cruz AMA.

#### **3.3.1.1 Large Providers**

There are four large municipal providers in the Santa Cruz AMA. The City of Nogales is the only municipality in the AMA that is a large provider. The other three large providers are Rio Rico Utilities, Valle Verde Water Company, and Citizens Utilities - Tubac. Table 3-5 summarizes the 1992 - 1995 average per capita information for the four large providers.

##### **3.3.1.1.1 City of Nogales**

The largest municipal provider, the City of Nogales, is a municipality whose service area is located predominately east of Interstate 19 with a small portion situated west of the interstate. The southern boundary of the service area is the international border. The service area encompasses approximately 32 square miles and includes areas both inside and outside the city limits. Municipal uses of water in the service area consist of residential demand, produce storage and processing, use by the tourist service industry, and light manufacturing. Two turf-related facilities, Palo Duro and Kino Springs golf courses, also use water supplied by the City of Nogales.



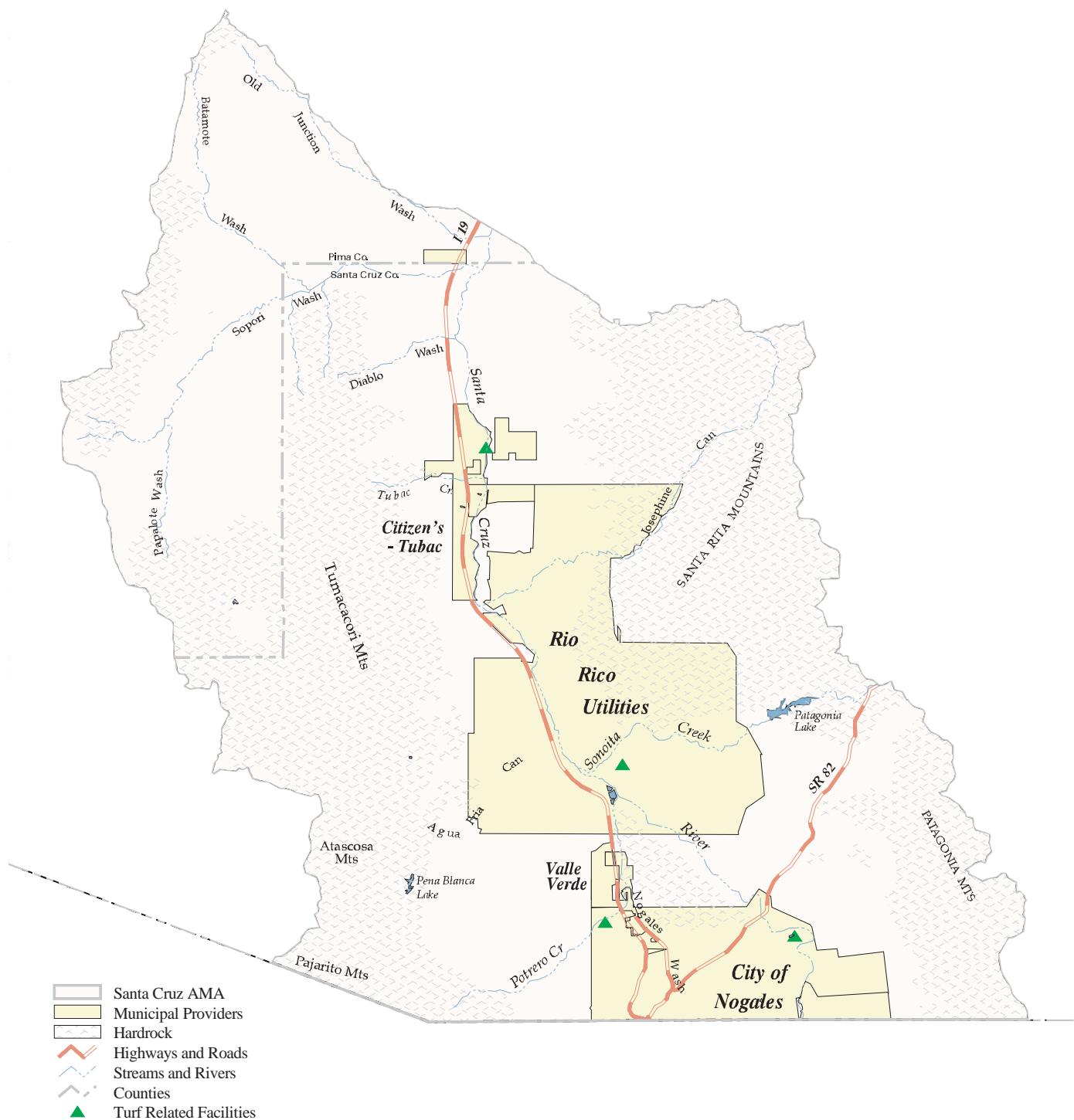
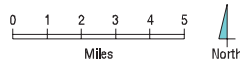


Figure 3- 4

### Municipal Water Provider Water Service Areas



Santa Cruz AMA 3- 8

ORIGINAL SOURCE  
Arizona Department of Water Resources  
Geographic Information System

**TABLE 3-4**  
**MUNICIPAL WATER DEMAND (ACRE-FEET)**  
**BY PROVIDER TYPE 1985 THROUGH 1997**  
**SANTA CRUZ ACTIVE MANAGEMENT AREA**

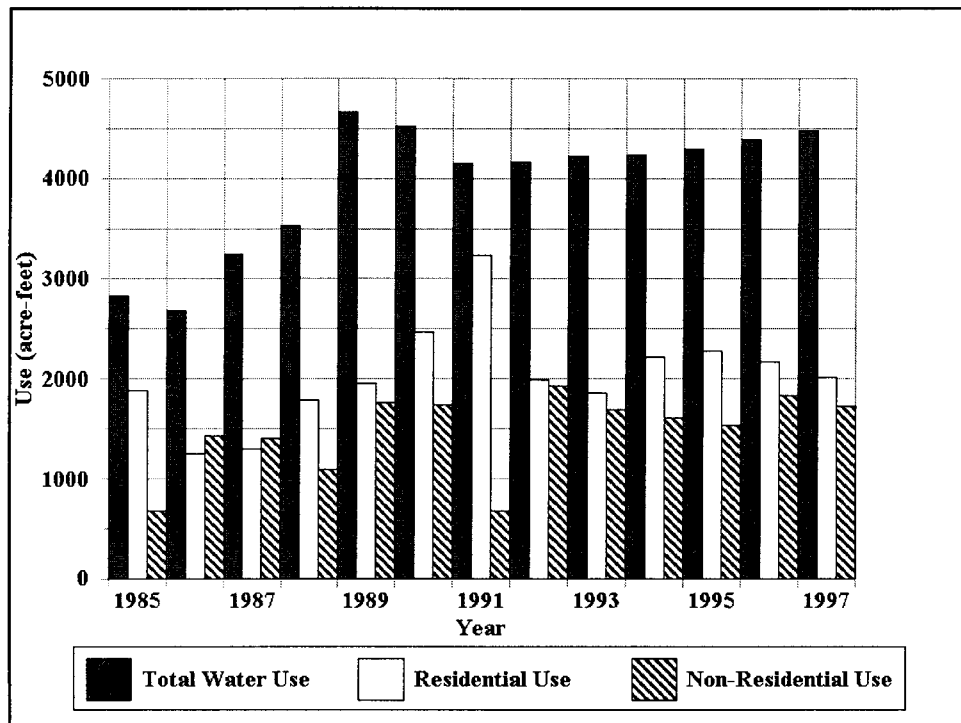
<b>Year</b>	<b>City of Nogales</b>	<b>Rio Rico Utilities</b>	<b>Valle Verde Water Co.</b>	<b>Citizens - Tubac</b>	<b>Small Providers</b>	<b>Total Municipal Water Demand</b>
<b>1985</b>	2,821	415	241	169	381	4,027
<b>1986</b>	2,683	421	265	223	331	3,923
<b>1987</b>	3,250	456	259	197	334	4,496
<b>1988</b>	3,532	579	290	187	330	4,918
<b>1989</b>	4,668	748	292	209	366	6,283
<b>1990</b>	4,529	678	291	212	358	6,068
<b>1991</b>	4,147	737	275	198	389	5,746
<b>1992</b>	4,169	935	288	211	403	6,006
<b>1993</b>	4,218	1,053	274	219	370	6,134
<b>1994</b>	4,239	1,155	299	246	392	6,331
<b>1995</b>	4,290	1,361	384	244	395	6,674
<b>1996</b>	4,386	1,440	347	253	421	6,847
<b>1997</b>	4,482	1,469	415	277	400	7,043

**TABLE 3-5**  
**1992-1995 AVERAGE SERVICE AREA CHARACTERISTICS**  
**LARGE MUNICIPAL PROVIDERS**  
**SANTA CRUZ ACTIVE MANAGEMENT AREA**

	<b>Nogales</b>	<b>Rio Rico</b>	<b>Valle Verde</b>	<b>Tubac</b>
<b>Total GPCD</b>	202	172	105	246
<b>Residential GPCD</b>	100	111	76	173
<b>Non-Residential GPCD</b>	81	39	19	38
<b>Lost %</b>	11%	11%	10%	13%

Total water use by the City has been steadily increasing since 1985. The City supplied 4,290 acre-feet in 1995. Per capita rates within the service area have fluctuated considerably over time, which may be due to a number of factors including weather conditions, distribution system difficulties, and record-keeping changes. Non-residential per capita use peaked in 1989 when Nogales merged another smaller service area (the Yerba Buena Water Company, which included the Kino Springs golf course) into its service area. The total per capita use rate in the Nogales service area has been extremely stable over the period from 1991 through 1997.

**FIGURE 3-5  
HISTORIC WATER USE  
CITY OF NOGALES  
SANTA CRUZ ACTIVE MANAGEMENT AREA**



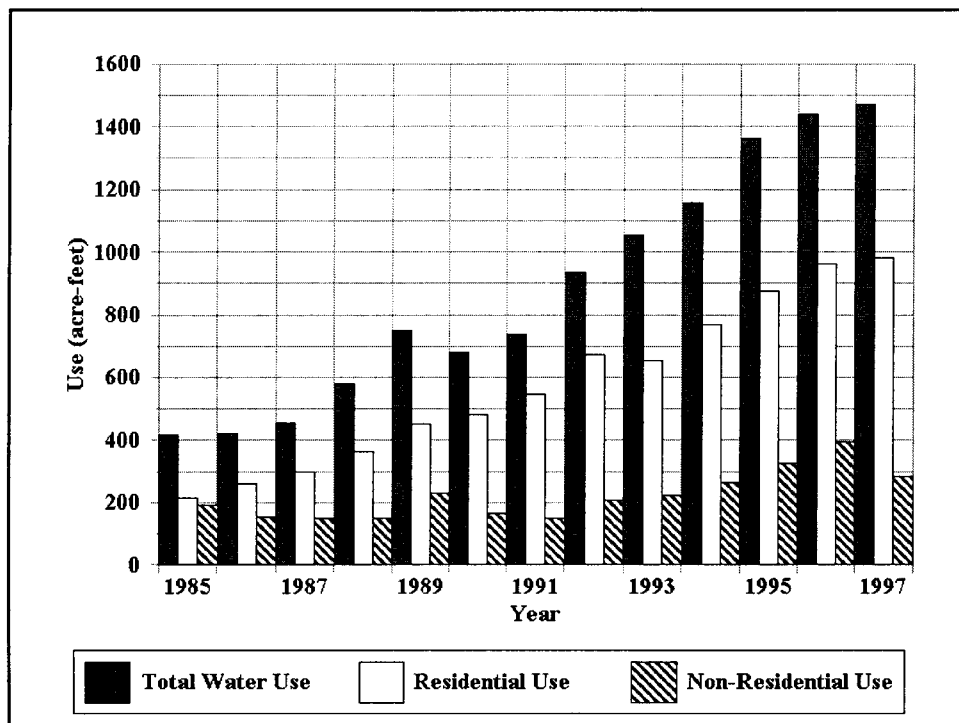
When comparing the GPCD rate of Nogales with that of other large municipal providers, both within the AMA and in other AMAs, Nogales' GPCD is significantly higher. This may be due in part to the greater proportion of non-residential water demand within the Nogales service area.

Part of this non-residential demand is due to sanitary and other water uses associated with the estimated 30,000 people who cross the international border from Nogales, Sonora into Nogales, Arizona each day. Some of these daily visitors spend the day with relatives and water use associated with this component of the daily population influx is reflected in Nogales' residential water demand. Residential water demand may also be impacted by visits from out-of-town family. Because visiting family members do not reside in Nogales, Arizona, they are not counted as service area population.

#### **3.3.1.1.2 Rio Rico Utilities**

The Rio Rico Utilities service area is situated in the central portion of the AMA, primarily on the east side of Interstate 19, with a small portion located to the west of the interstate. The service area comprises nearly 79 square miles. Water use in the Rio Rico service area has increased from 415 acre-feet in 1985 to 1,361 acre-feet in 1995. The non-residential per capita use rate has decreased in the service area as residential development has filled in around the golf course. The residential per capita rate fluctuates with weather conditions, but shows a reduction between 1989 and 1994.

**FIGURE 3-6  
HISTORIC WATER USE  
RIO RICO UTILITIES  
SANTA CRUZ ACTIVE MANAGEMENT AREA**



There were 6,737 people served through Rio Rico Utilities in 1995. The daily use rate in 1995 was 180 GPCD. The 1992 through 1995 average GPCD rate for the Rio Rico Utilities service area was 172 GPCD. Water use consists of residential domestic demand and tourist service industry needs. The Rio Rico service area, unlike Nogales, is located downstream of the Nogales International Wastewater Treatment Plant (NIWWTP). While the potential for growth in the Rio Rico service area is much greater than that of Nogales, Rio Rico may benefit from a more continuous water availability due to its location downstream from the NIWWTP, as long as effluent continues to be discharged at historic rates.

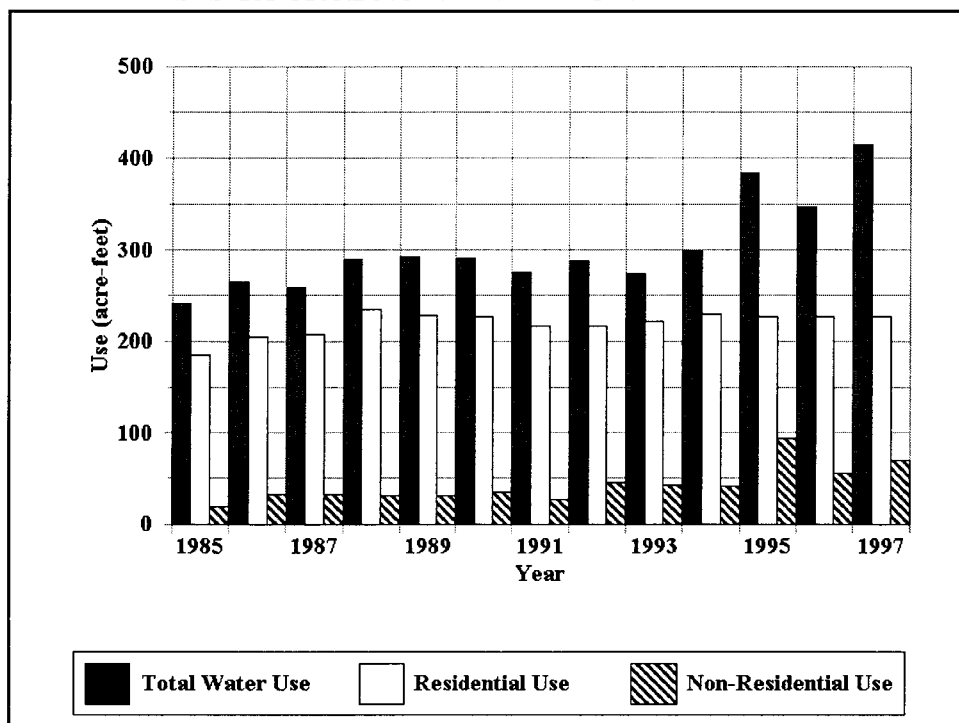
#### **3.3.1.1.3 Valle Verde Water Company**

The Valle Verde Water Company service area lies along Interstate 19 and Nogales Wash. It encompasses approximately two square miles and provided water supplies to 2,734 people in 1995. The daily water use rate was 125 GPCD in 1995 with 384 acre-feet of water delivered. The 1992 through 1995 average GPCD rate was 105 GPCD. Municipal water uses include residential domestic demand, two schools, and tourist service industry needs. Valle Verde is a small service area that can be significantly impacted by the addition of a large user. For many years, the population of the service area was nearly static, but recent growth and the addition of the new schools to the water service area have resulted in an increase in the overall service area GPCD rate.

#### **3.3.1.1.4 Citizens Utilities - Tubac**

Citizens Utilities - Tubac service area is north of Rio Rico, roughly between Chavez Siding Road and Santa Gertrudis Lane, paralleling Interstate 19. The service area is fairly small, the provider having just

**FIGURE 3-7  
HISTORIC WATER USE  
VALLE VERDE WATER COMPANY  
SANTA CRUZ ACTIVE MANAGEMENT AREA**



begun using over 250 acre-feet per year in 1996. Water use by Citizens - Tubac was 244 acre-feet in 1995.

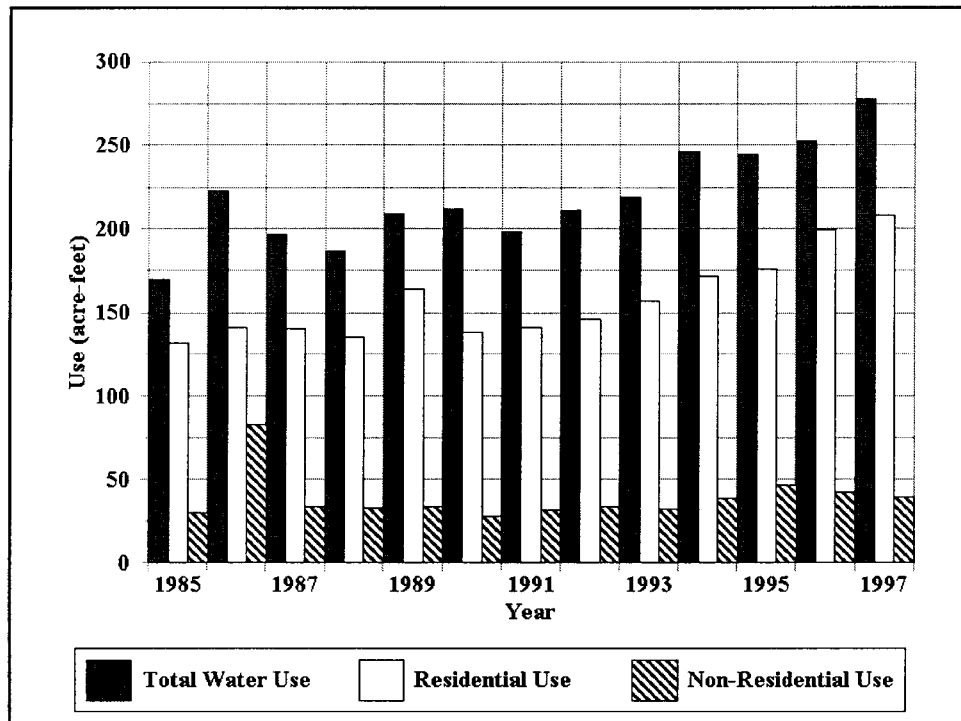
The 1995 GPCD rate for this provider was 254 GPCD. The 1992 to 1995 average GPCD rate in the service area was close to this at 253 GPCD. Uses are mostly for residential purposes; typically single family homes. The GPCD rate for Citizens - Tubac is higher than the other large providers primarily due to the low number of persons per household and the lush landscapes common in some subdivisions, and several properties are large with small pastures for horses and other livestock. Citizens - Tubac serves some small commercial establishments, including some art galleries, restaurants, shops, and studios; however, the water use associated with commercial uses is not great.

### 3.3.1.2 Small Municipal Providers

There are currently 10 active small municipal providers in the Santa Cruz AMA. Figure 3-9 shows the average GPCD rate and volume of water used by small municipal providers between 1985 and 1997. The 1985 - 1995 average GPCD rate for small providers in the Santa Cruz AMA was 172 GPCD, however, based on the available data, the average annual GPCD rate for small providers fluctuates over time. This may be due to the impact of rainfall on exterior water use by small provider customers. In addition, the data collected from small providers are generally not as accurate as the information collected from large providers in the AMA.

In 1994, a legislative change to the large provider definition resulted in two of the large providers being reclassified as small providers; Citizens Utilities - Tubac and Lakewood Water Company. Citizens - Tubac regained large municipal provider status in 1996 and will be regulated as a large provider in the third management period.

**FIGURE 3-8  
HISTORIC WATER USE  
CITIZENS UTILITIES - TUBAC  
SANTA CRUZ ACTIVE MANAGEMENT AREA**

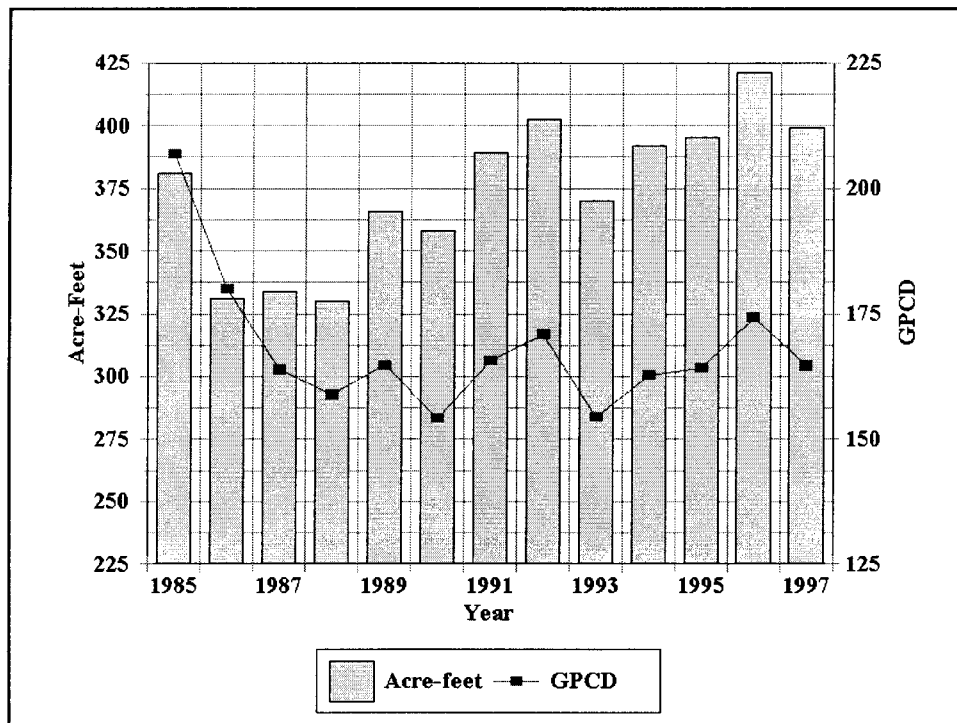


Lakewood Water Company will not be regulated as a large provider until the annual water pumped, diverted, or received in a calendar year is 250 acre-feet or more. Table 3-6 provides recent information on Lakewood Water Company.

The 10 small providers are divided into the following categories: three mobile home or RV parks, two private water companies regulated by the Arizona Corporation Commission, and five miscellaneous providers. Miscellaneous small providers include well cooperatives, ranch housing, or small housing complexes which operate exempt wells. While the majority of small provider water deliveries are made to residential customers, per capita usage is highly variable due to differences in water costs, household income, and lifestyle.

Population for small municipal providers was estimated using the average occupancy rate and persons per household figures from the 1990 U.S. Census for the Nogales County Control Division, except for Lakewood Water Company which is located in Pima County. In order to calculate the population served each year, the number of housing units served by small providers, as reported on the Annual Water Withdrawal and Use Reports, were tallied and then multiplied by the county average occupancy rate and persons per occupied housing unit.

**FIGURE 3-9  
HISTORIC WATER USE  
SMALL MUNICIPAL PROVIDERS  
SANTA CRUZ ACTIVE MANAGEMENT AREA**



**TABLE 3-6  
LAKEWOOD WATER COMPANY WATER USE CHARACTERISTICS  
1992 - 1997  
SANTA CRUZ ACTIVE MANAGEMENT AREA**

		1992	1993	1994	1995	1996	1997	92-95 Ave
Lakewood Water Co.	GPCD	133	139	147	153	153	150	143
	Use	134	136	145	150	150	148	141
	Pop.	900	874	877	877	877	877	882

### 3.3.2 Municipal Water Supply

Historically, municipal providers in the Santa Cruz AMA have relied primarily on wells within the Younger Alluvium of the Santa Cruz River to provide a potable water source for residents and industries. Recently, the City of Nogales has begun to consider alternative sources of supply to its two municipal wellfields, one in Potrero Canyon (Potrero Creek) and the other near Highway 82 in the Santa Cruz River.

If Nogales is successful in its search for alternative supply sources and in the implementation of additional water management techniques, the municipal water supply for the Nogales customers should be more secure during times of drought. All municipal providers are encouraged to explore the option of the direct

use of effluent for such purposes as golf course irrigation. If main supply wells continue to pump from the Younger Alluvium of the Santa Cruz River, this aquifer may be susceptible to long-term water level declines as demand increases as well as during periods of prolonged drought conditions.

Direct reuse of effluent has not occurred to a significant degree in the Santa Cruz AMA. However, effluent discharge from the NIWWTP is a major source of supply contributing to the maintenance of water levels in the Younger Alluvium downstream of the plant. It is unclear whether this discharge will continue to be available in the future. However, as development increases, the construction of small, local wastewater treatment plants to serve individual subdivisions could create new sources of effluent supply in new locations, which can be reused. The installation of septic systems may not result in replenishment of the aquifer and may not provide for reuse of the water resource.

### **3.3.3 Municipal Sector Issues**

Growth in the municipal sector is influenced by the economies both of the United States and Mexico. Increases in the daily traffic across the international border increases non-residential water demand in the City of Nogales water service area. As more jobs are created in southern Arizona, demand will continue for new home construction. Individuals looking to retire will continue to move to southern Arizona for its many amenities. As population and water demand increase, achievement of the AMA goals will become increasingly challenging. Water withdrawn from small private (exempt) wells is not required to be reported to the Department and is not subject to water conservation requirements. High concentrations of exempt wells may have an impact on local water table levels in some areas. Additional analysis of the potential impacts of exempt wells requires further study.

#### **3.3.3.1 Non-Resident Water Uses**

The issue of international traffic associated with family visiting across the border is primarily an issue for the City of Nogales. The City's residential GPCD rate may be inflated because visiting family members who do not reside in the service area cannot be counted as service area population. This could result in overestimation of the conservation potential for existing residential users in the City's service area. In order to make an adjustment to the existing residential conservation potential, additional information must be obtained that allows quantification of this possible effect. The City would have to apply for an administrative review of its conservation requirements pursuant to A.R.S. § 45-575(A) before the Department could make an adjustment to the existing residential conservation potential.

#### **3.3.3.2 Exempt Well Use**

Wells with pump capacities less than or equal to 35 gallons per minute (gpm) are exempt from most of the provisions of the Code. With few exceptions, withdrawals from such wells may not exceed 10 acre-feet per year. Many exempt wells withdraw water from within the Younger Alluvium. The locations of exempt wells often overlap areas of municipal demand. The result of this concentration of demand could potentially restrict water availability to all users during periods of drought.

Many exempt wells are located near the Santa Cruz River and other tributaries and away from hardrock areas. Although new development is occurring on the Older Alluvium and new exempt wells are being drilled there, especially near Tubac. Water withdrawals associated with a cluster of several exempt wells, especially if it occurs in the microbasin area of the AMA, could potentially impact local water table levels. As assured water supply consistency with management goal criteria are drafted, adopted, and implemented for the Santa Cruz AMA, the number of applications to drill exempt wells could increase due to an increase in the number of dry-lot subdivisions (subdivisions that are not served from a central water distribution system). Although existing exempt wells are widespread and are considered to have little impact on water tables or water supplies, the Department may need to begin to focus additional attention



on analysis of the impacts of dry-lot subdivisions on the AMA goals, particularly in regards to the protection of local water table levels portion of the goal. A preliminary effort to gage the volume of exempt well demand has been prepared by the Department and is discussed in Chapter 5.

### **3.3.3.3 Water Use in Nogales, Sonora**

The two communities of Nogales, Arizona and Nogales, Sonora share water resources, a wastewater collection and treatment system, and an international line which economically divides the communities as much as it unifies them. Nogales, Sonora has an official population estimate of 205,000 but unofficial estimates are considerably higher. Nogales, Sonora has undergone extremely rapid growth during recent years due to the establishment of foreign-owned factories called *maquiladoras*. The factories are located in Mexico to capitalize on the ability to manufacture products inexpensively. Increased migration to border communities such as Nogales is linked to an increase in employment opportunities and the prospect of an improved standard of living.

The *maquila* industry has led to an explosive rate of growth in several Mexican border communities. Since the economic development of the Mexican communities is unable to keep pace with the population growth, infrastructure improvements lag behind. It has been estimated that less than half of the population in Nogales, Sonora has 24 hour per day water service. A sizeable minority of the population does not have any direct access to potable water within their homes. The State of Sonora currently does not measure pumpage at their wells but best available estimates indicate that the residential per capita rate is about 40 GPCD (IBWC, 1997). Not all the water transmitted through the distribution system is delivered to the water customers due to a fairly high percentage of system losses.

Nogales, Sonora has developed a water supply plan in response to the current water shortage. Further detail on this plan is described in Chapter 8.

## **3.4 INDUSTRIAL WATER USE CHARACTERISTICS**

Industrial water users pump water from their own wells pursuant to a Type 1 or Type 2 non-irrigation grandfathered right or a groundwater withdrawal permit. These rights and permits have annual volumetric allotments. Industrial users are subject to annual conservation requirements described in Chapter 6. All industrial users have general conservation requirements. In addition, the following industrial user groups in the Santa Cruz AMA have specific conservation requirements:

- Turf-Related Facilities ( $\geq 10$  acres)
- Sand and Gravel Facilities ( $>100$  acre-feet/year)
- New Large Landscape Users ( $>10,000$  square feet)
- New Large Industrial Users ( $>100$  acre-feet/year)

### **3.4.1 Industrial Water Demand**

In the Santa Cruz AMA, industrial water demand fluctuates depending mostly on weather conditions. While industrial water use is limited by the total volume of grandfathered rights and permits, some new permits can be issued to support industrial uses. Industrial use has been relatively constant since 1985, although peaks in use have occurred periodically, generally during years of unusually hot and dry weather.

#### **3.4.1.1 Historic and Current Demand**

Beginning in 1987, the reporting requirements of the First Management Plan went into effect and the data reported by industries to the Department improved. As a proportion of overall AMA demand, industrial use has remained fairly constant over time as shown in Figure 3-10.

**FIGURE 3-10  
HISTORIC WATER USE  
INDUSTRIAL SECTOR  
SANTA CRUZ ACTIVE MANAGEMENT AREA**

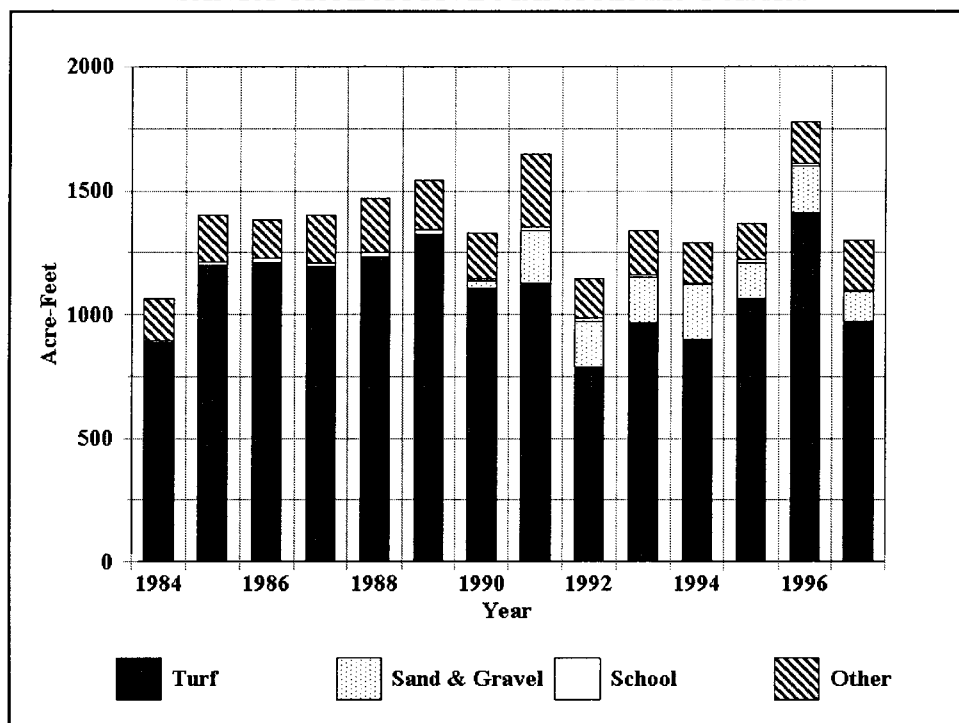


Table 3-7 contains detailed water use information for 1995, including the number of industrial facilities by category, associated water rights and permits, and the volume used in 1995. Industrial users currently use considerably less water than they are entitled to use pursuant to their grandfathered water right and permit allotments. The actual allotment associated with the industrial sector is 9,248 acre-feet per year not including hydrologic testing permits. The difference between the allotment volume and actual use is partially explained by the process used to establish grandfathered water rights. Type 2 non-irrigation grandfathered right allotments for industrial users were based on the highest volume of water withdrawn from 1975 to 1980. Some industrial users have ceased operations entirely, although they have retained their water rights. Industrial uses accounted for about 1,363 acre-feet of water in 1995, representing 7 percent of total AMA water use (Table 3-1).

### 3.4.1.2 Water Demand by Industrial Subsector

#### 3.4.1.2.1 Turf-Related Facilities

Turf-related facilities constitute the largest industrial user category in the Santa Cruz AMA and include two golf courses. Two additional courses, Palo Duro and Kino Springs, are served by the City of Nogales and are considered individual users. See Chapter 5 for more detail on individual users. The two industrial facilities, Rio Rico and Tubac Ranch Properties, withdraw water pursuant to Type 2 non-irrigation rights. In 1995, 1,063 acre-feet of water was used by the Rio Rico and Tubac courses for watering turf grass and other landscaping, and for filling lakes and ponds.

There are several schools in the Santa Cruz AMA; however, none of these are regulated as turf-related facilities because the total turfed area at each school is less than 10 acres.

**TABLE 3-7**  
**INDUSTRIAL WATER RIGHTS AND WITHDRAWAL SUMMARY - 1995**  
**SANTA CRUZ ACTIVE MANAGEMENT AREA**

User Category	Type of Right or Permit	Number of Facilities	Right & Permit Allotments (Acre-Feet)	1995 Use (Acre-Feet)
Sand & Gravel	Mineral Extraction - ZZ Cattle Corp.	1	276	141
Sand & Gravel	Mineral Extraction - Abe's Materials	1	75	0.53
Sand & Gravel	Mineral Extraction - Multi-Metals Inc.	1	23	1
School	Type 2 - Nogales Unified School District #1	1	17	4.38
School	General Industrial Use Permit - Sahuarita Unified School	1	12	10.2
Turf	Type 2 - Rio Rico Properties, Inc.	1	860	585.64
Turf	Type 2 - Tubac Ranch Properties	1	706	477
Various	Type 1 (total number of rights)	11	5,962.66	1
Various	Type 2 (other than Turf and schools)	35	826.1	139.82
Various	Other Permits	2	490	4.06
<b>TOTAL</b>			<b>9,248</b>	<b>1,365</b>

#### **3.4.1.2.2 Sand and Gravel Facilities**

Although there is more than one sand and gravel operation using water in the Santa Cruz AMA, only one operation is large enough to be regulated as an industrial sand and gravel operation. The ZZ Cattle Corporation used 141 acre-feet in 1995 and is steadily increasing its production of rock products. This facility currently withdraws water pursuant to a mineral extraction permit issued by the Department. Permits are generally issued for a 10-year period and must be renewed through an application process.

#### **3.4.1.2.3 Other Subsectors**

The remainder of industrial water use in the Santa Cruz AMA is not specifically categorized. However, other industrial users include produce packaging industries, commercial businesses and light industries, recreation, stock water, schools, and parks. During the third management period, the Santa Cruz AMA will review other industrial uses to determine if additional subsector programs are needed. In 1995, the remaining industrial users reported 161 acre-feet of water withdrawn.

### **3.4.2 Industrial Water Supplies**

As of 1997, all industrial users in the Santa Cruz AMA use water withdrawn from wells to meet their water needs.

### **3.4.3 General Issues in the Industrial Sector**

Major issues that the industrial sector will be facing during the third management period include the potential for additional golf courses to be built that utilize water withdrawn from wells and the impact of any increased demand on the AMA's safe-yield and local water table level maintenance goals. Unused allotments associated with industrial rights represent a significant potential demand. Type 2 grandfathered rights can be moved from one parcel of land to another where new wells can be drilled. This could impact the AMA's ability to manage local water tables.

Rights and permits held by industrial users fluctuate from year to year as permits expire and rights are conveyed or retired. Currently, the total volume of water allotted to industrial rights and permits is about 9,000 acre-feet. While some of the unused allotment may never actually be put to use, it is not possible to predict future utilization.

### **3.5 RIPARIAN AREA DEMAND**

Riparian area demand is currently the largest demand in the Santa Cruz AMA. This demand is made up of the water consumed by dense vegetative tracts along the Santa Cruz River's effluent-dominated perennial reaches. Estimates of riparian area water demand have been calculated previously (USBR, 1952; Harshbarger, 1970; ADWR, 1989; Coggeshall, 1990; ADWR, 1996; and MacNish, 1997). Revised estimates of riparian acreage and evapotranspiration in the Santa Cruz AMA for 1954 and 1995 are being developed by the Department using new data retrieved from digitized aerial photographs covering the area. Preliminary results indicate an increase in riparian acreage from about 6,200 acres in 1954 to about 8,600 acres in 1995. Calculation of vegetation type/density acreage and associated consumptive use was accomplished by digitizing information interpreted from aerial photos for both years. The preliminary estimate of the total annual riparian evapotranspiration was about 17,500 acre-feet in 1954, and about 25,800 acre-feet in 1995. Most of the increase in riparian acreage and associated evapotranspiration occurred along the Santa Cruz River downstream from the NIWWTP. Effluent discharge from this site has had a substantial role in the development of a perennial stream reach which supports the riparian habitat. Other factors may include shifts in long-term climatic patterns or agricultural activity.

Riparian areas expand and thrive where the water table is maintained. Effluent being discharged into the Santa Cruz River has so far stabilized water table levels in a portion of the Younger Alluvium. However, as human water demands increase and the availability of effluent remains uncertain, the riparian habitat may become threatened. Conversely, if effluent generation increases through an expanded population and improved wastewater collection system, greater volumes of effluent discharge could actually stimulate riparian growth and riparian area demand.

### **3.6 WATER DEMAND COMPONENTS**

This section provides a description of the water demand components which are included in the water resource analysis contained in Chapter 11 of this plan. This information will assist in developing an understanding of the fluctuating supply characteristics of the Santa Cruz AMA and the impact of this condition on the AMA's water management goals. The information contained in this plan will be updated as new data becomes available. Supply components are contained in Chapter 2 of this plan.

Table 3-8 below contains water demand information for each water use sector for recent years. Hydrologic and natural demand factors are listed as a range where such information is available. Other values are 1992-1995 averages. The natural demand components of this table were prepared in 1997 by the Department's Hydrology Division. This information will be updated as the Department's hydrologic model for the Santa Cruz AMA is completed and additional data is collected from the field.

**TABLE 3-8**  
**ANNUAL WATER DEMANDS**  
**SANTA CRUZ ACTIVE MANAGEMENT AREA**  
**(Figures Rounded to Nearest 100 Acre-Feet)**

<b>Component</b>	<b>Time Period</b>	<b>Average or Range in Acre-Feet</b>
Municipal Demand	1992-1995	6,300
Agricultural Demand	1992-1995	11,300
Industrial	1992-1995	1,300
Riparian Demand	estimated	25,800
Underflow Leaving the AMA	estimated	6,800 - 10,600
<b>TOTAL OUTFLOWS</b>		<b>51,500 - 55,300</b>

### **3.6.1 Groundwater Underflow Leaving the Santa Cruz AMA**

Estimates of underflow leaving the Santa Cruz AMA at the northern boundary range from 6,800 acre-feet per year for the Younger Alluvium aquifer only (ADWR, 1997) to 10,600 acre-feet per year for the combined Younger and Older Alluvial aquifers (Travers and Mock, 1984).

### **3.6.2 Riparian Evapotranspiration**

Significant ET losses occur along the riparian corridor of the Santa Cruz River. Other riparian areas include Nogales Wash, Sonoita Creek, and Sopori Wash. Estimates of riparian acreage, as previously noted in this chapter, were made from an analysis of 1995 aerial photography. Riparian acreage was divided into two major classes: mesquite, and cottonwood/willow. These major classes were further subdivided into low, medium, and high density classifications. Estimated effective precipitation was subtracted from the consumptive use values for various densities of mesquite and cottonwood/willow. The resulting values were multiplied by their respective acreages to estimate maximum riparian evapotranspiration.

An evapotranspiration reduction factor was estimated by first subtracting the University of Arizona's estimate of total riparian evapotranspiration from the NIWWTP to Santa Gertrudis Lane (3,300 acre-feet/year) from the Department's maximum estimate for the same river segment (4,100 acre-feet/year). It was assumed that the difference between the two estimates (800 acre-feet) was solely due to the amount of evapotranspiration supplied by precipitation rather than water in storage. This assumption seemed reasonable because the University of Arizona estimate was already reduced to account for precipitation on the riparian area. A reduction factor of .58 acre-feet per riparian acre was calculated by dividing the difference (800 acre-feet) by the total riparian acreage in that river segment (1,380 acres).

### **3.6.3 Water Withdrawals**

Agricultural, industrial, and municipal pumpage was derived from annual water use reports submitted to the Department by all regulated water users in the Santa Cruz AMA. The average annual water use for each sector was developed from 1992-1995 annual use data. This data is compiled in the Registry of Groundwater Rights (ROGR) database. Pumpage associated with exempt wells was not included in this water resource analysis since annual use is not reported to the Department.

### **3.7      SUMMARY AND CONCLUSIONS**

Increases in water demand in the Santa Cruz AMA are primarily associated with the municipal water use sector. Although agricultural water demand fluctuates from year to year, new irrigated land cannot be brought into production within an AMA. Industrial demand has been fairly stable for many years, although there is a significant volume of unused industrial water rights in the Santa Cruz AMA.

Natural system demands include riparian area consumption and water that flows out of the AMA as subflow (beneath the land surface). These figures have been estimated and the range in estimates is included for outflow. Riparian demand is currently the largest demand category in the Santa Cruz AMA.

Chapter 2 highlighted the variability in seasonal and annual surface flow on the Santa Cruz River. Because natural system supplies vary, increases in demand will need to prepare for drought periods and find ways to store available supplies during years where supplies are abundant. Chapter 11 examines a range in conditions that might exist in the future by comparing demand projections under current and increased efficiency scenarios and minimum and maximum natural recharge.